Hard-to-Soft State Transitions in Bright Neutron Star and Black Hole X-Ray Binaries

Yan Zhen & Yu Wenfei

Shanghai Astronomical Observatory

April 27, 2008

Outline

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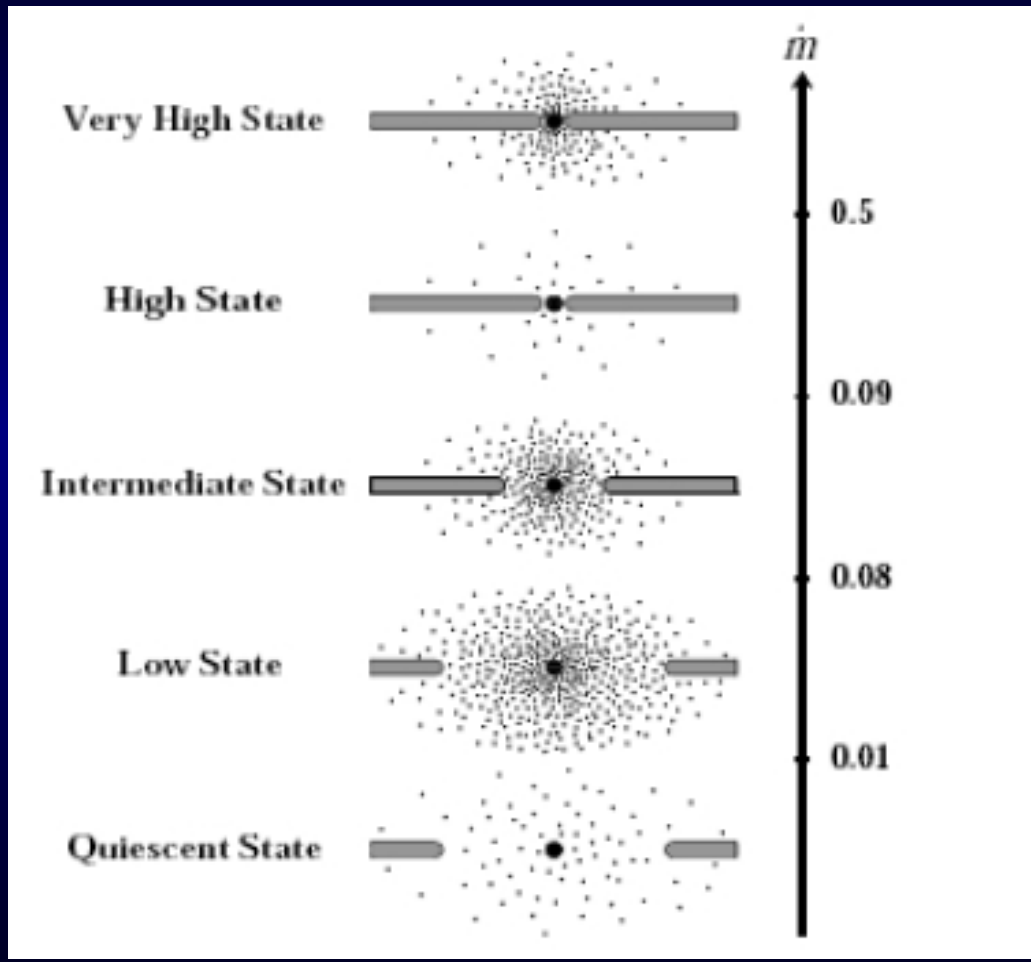
Black Hole Systems

- Quiescent State
- Low/Hard State
- Intermediate State
- High/Soft State
- Very High State



Esin et al. 1997

Neutron Star Systems of LMXBs

Atoll Sources

- Island State
- Lower Banana
- Upper Banana

Z Sources

- Horizontal Branch
- Normal Branch
- Flaring Branch

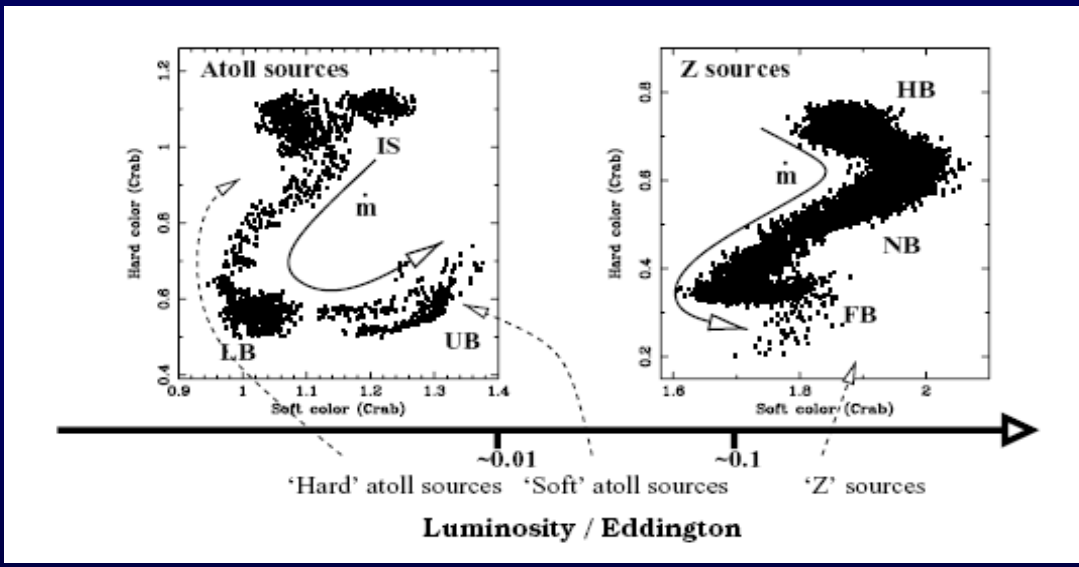
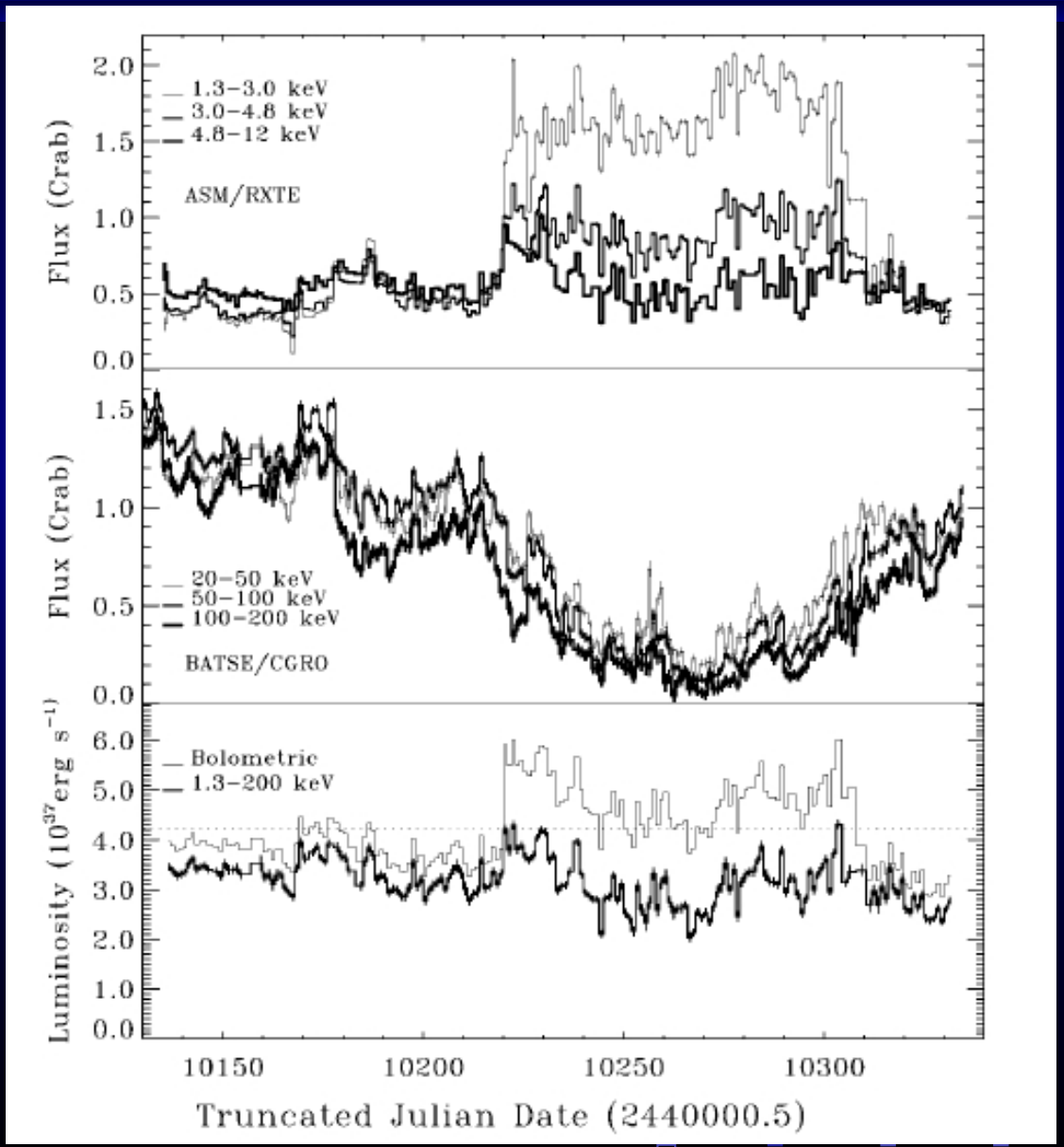


Figure is from Migliari & Fender (2006)

State Transition

State transition of Cygnus X-1

Zhang et al. (1997)



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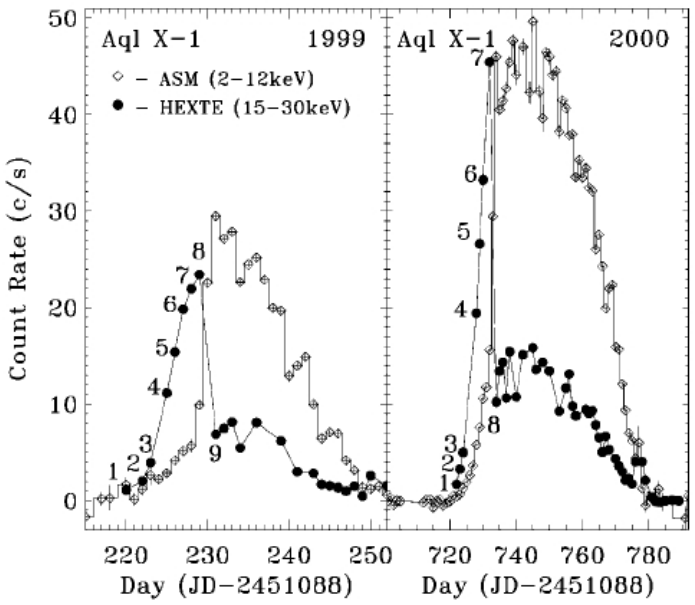
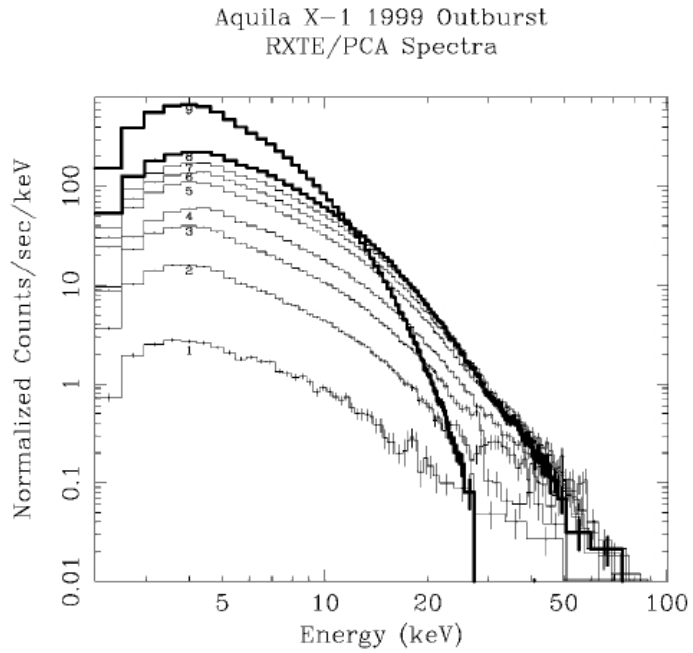
Hard-to-Soft State Transition in SXTs

The outburst rise of these outbursts was associated with the hard-to-soft state transition.

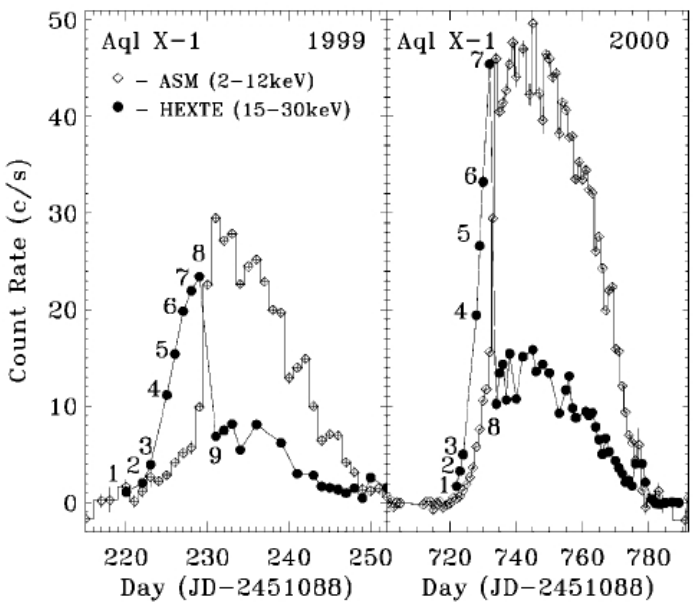


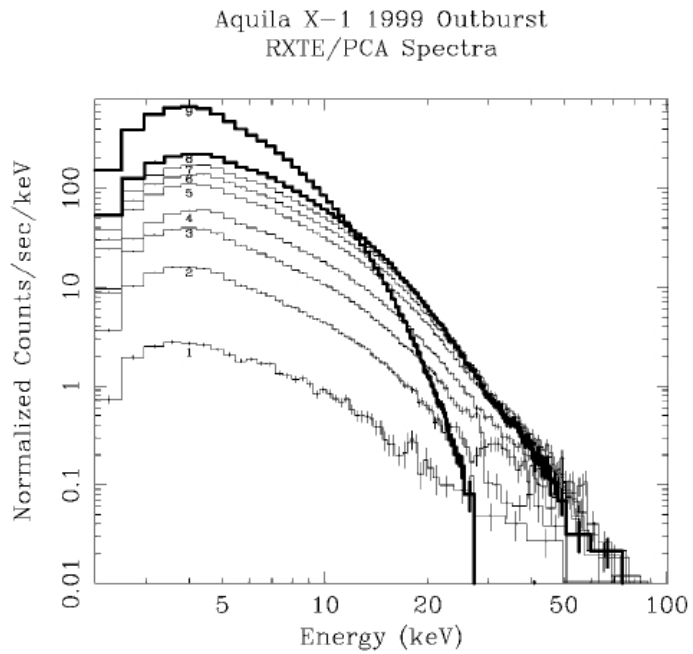


Yu et al. (2003)

Hard-to-Soft State Transition in SXTs

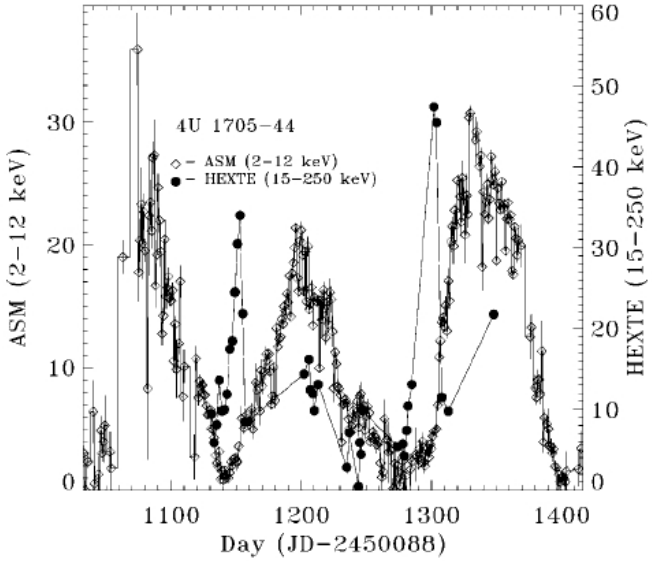
In both neutron star and black hole systems, an apparent hard flare will be observed if there is an initial low/hard state associated with a state transition occurring in the outburst rise.

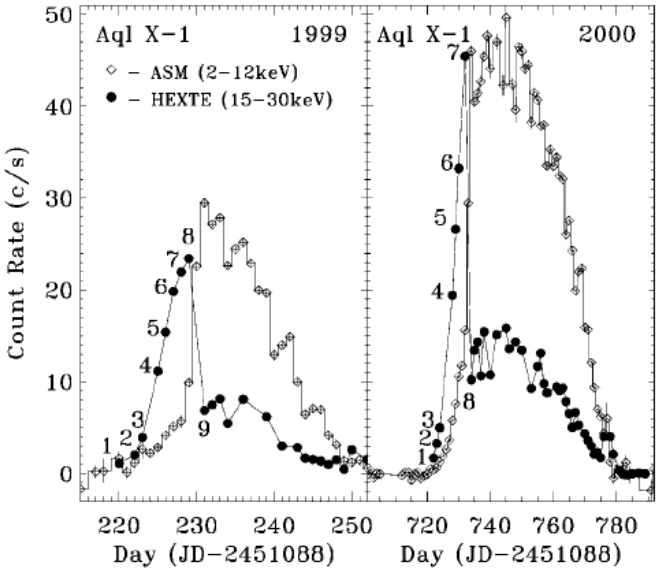


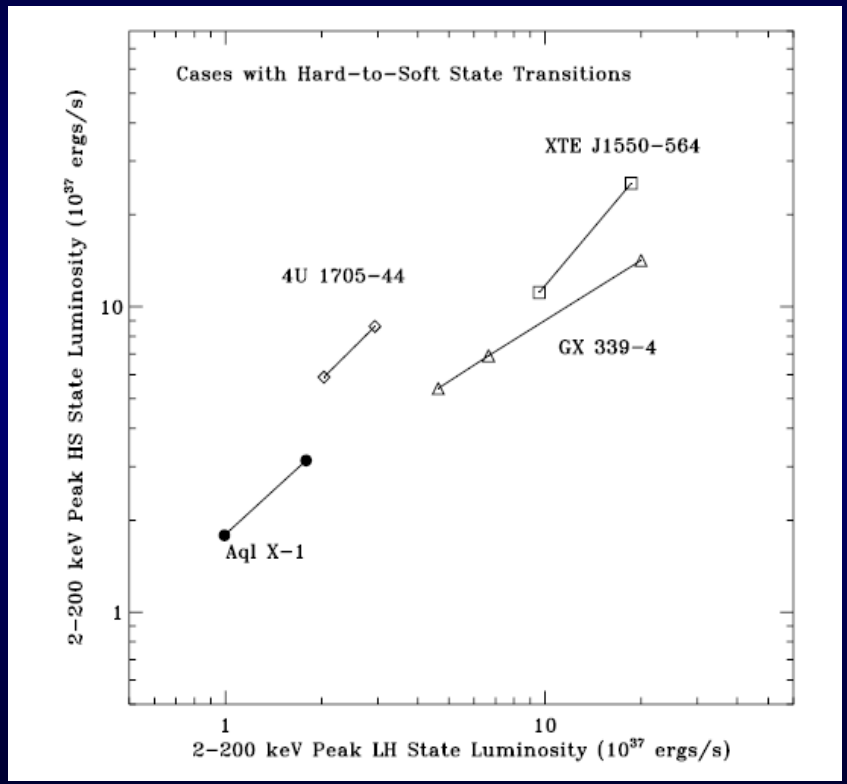


Yu et al. (2003)

Near Linear Correlation







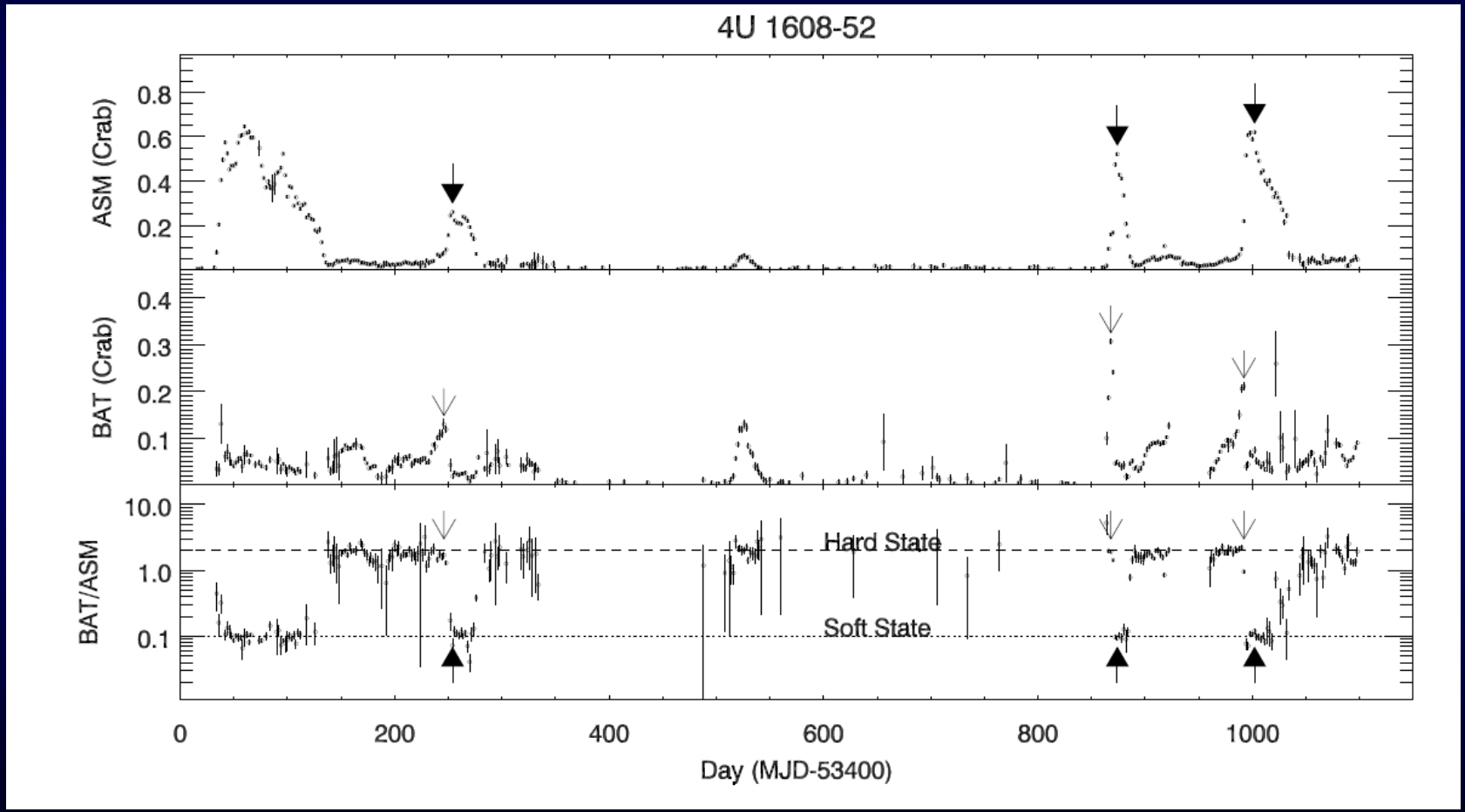
Yu et al. (2003), Yu et al. (2004)

Outline

ASM and BAT

- Swift/Burst Alert Telescope (BAT, 15-50 keV)
- Rossi X-Ray Timing Explorer(RXTE)/All Sky Monitor (ASM, 2-12 keV)
- ASM and BAT both can provide nearly on a daily basis monitoring of the X-ray sky
- The overlap time of them is about from February 12, 2005 (MJD 53413) to February 8, 2008 (MJD 54504)

Examples



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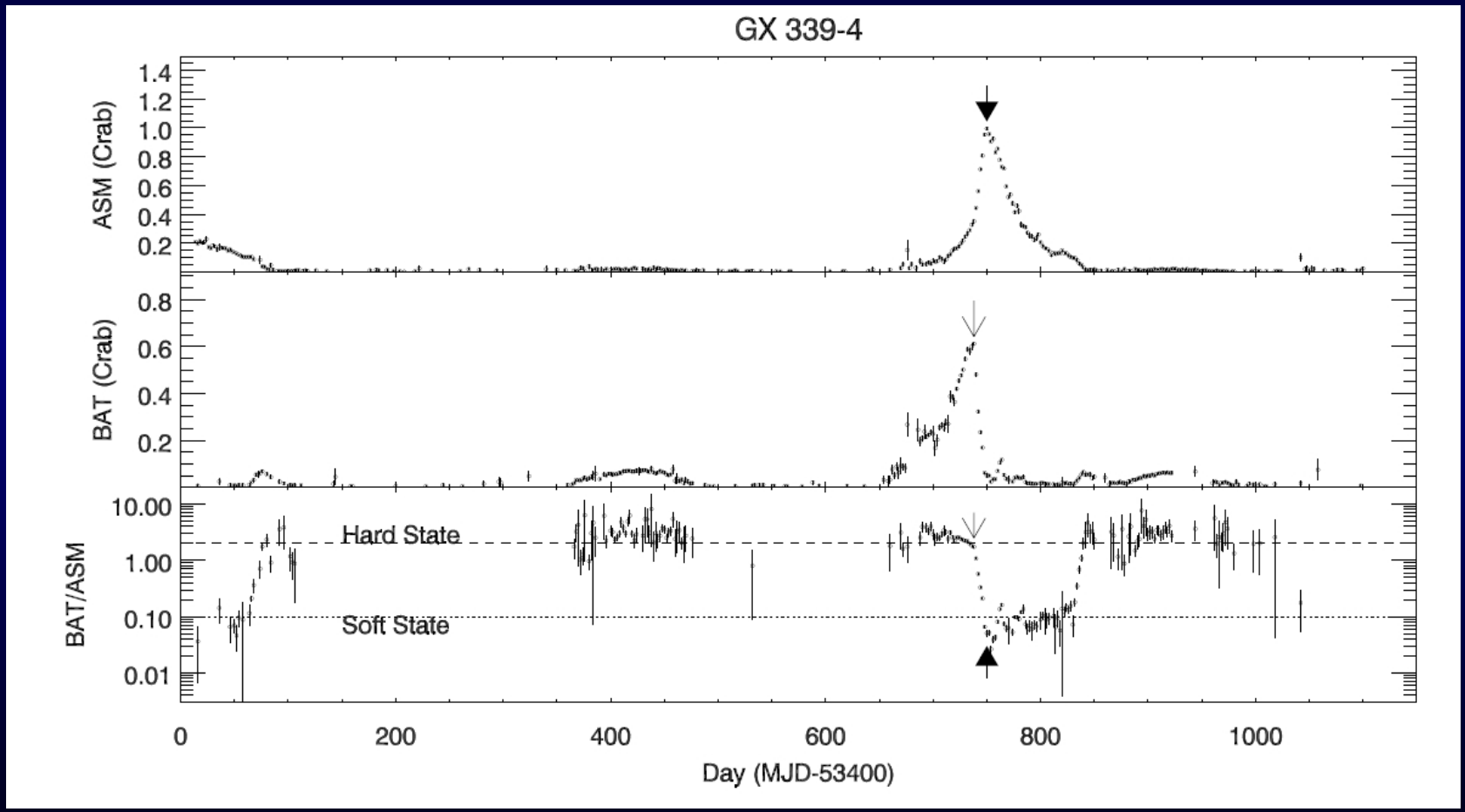
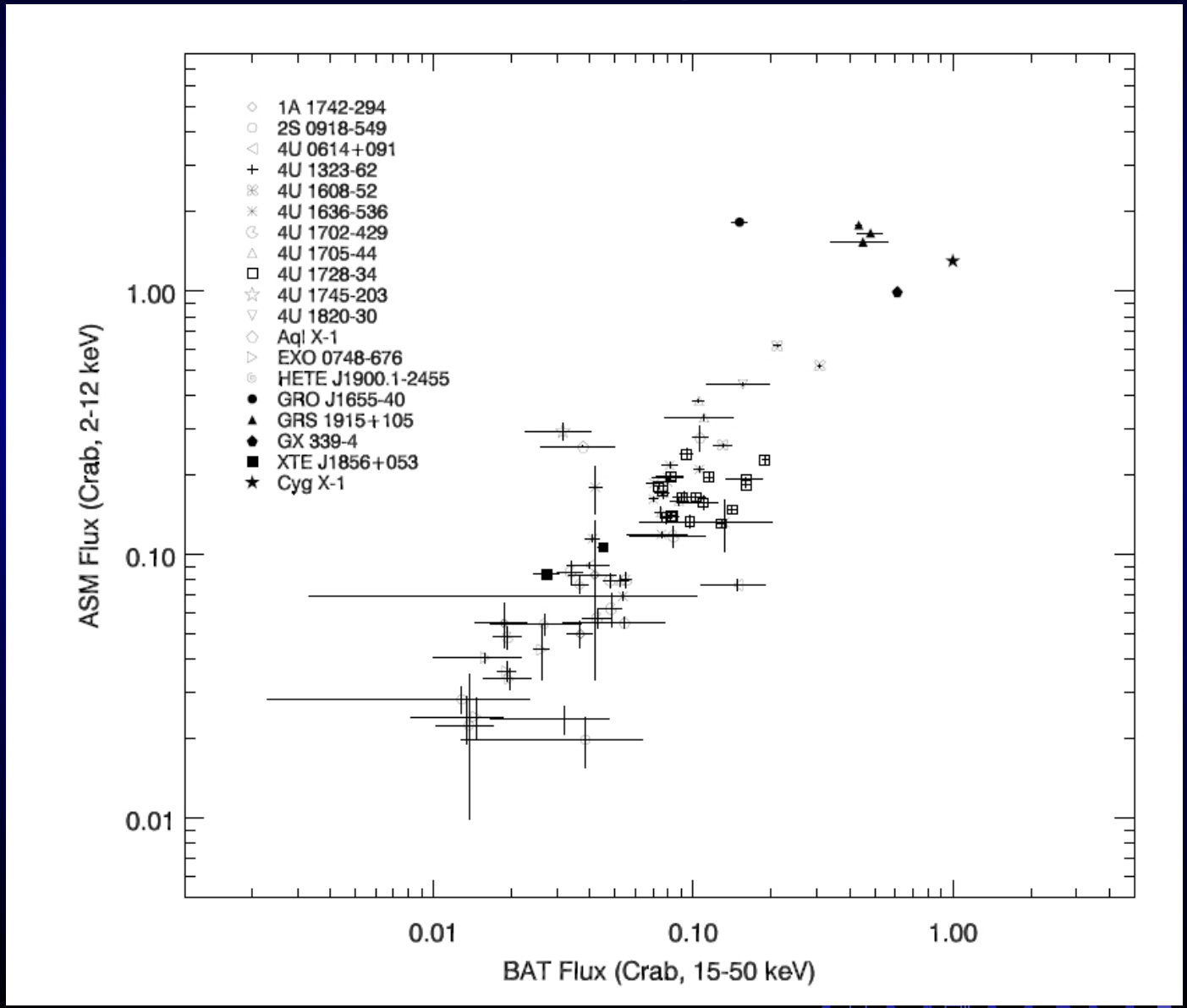


Outline

Correlation Between Luminosity of Hard-to-Soft State Transition and Peak Luminosity of Following Soft State



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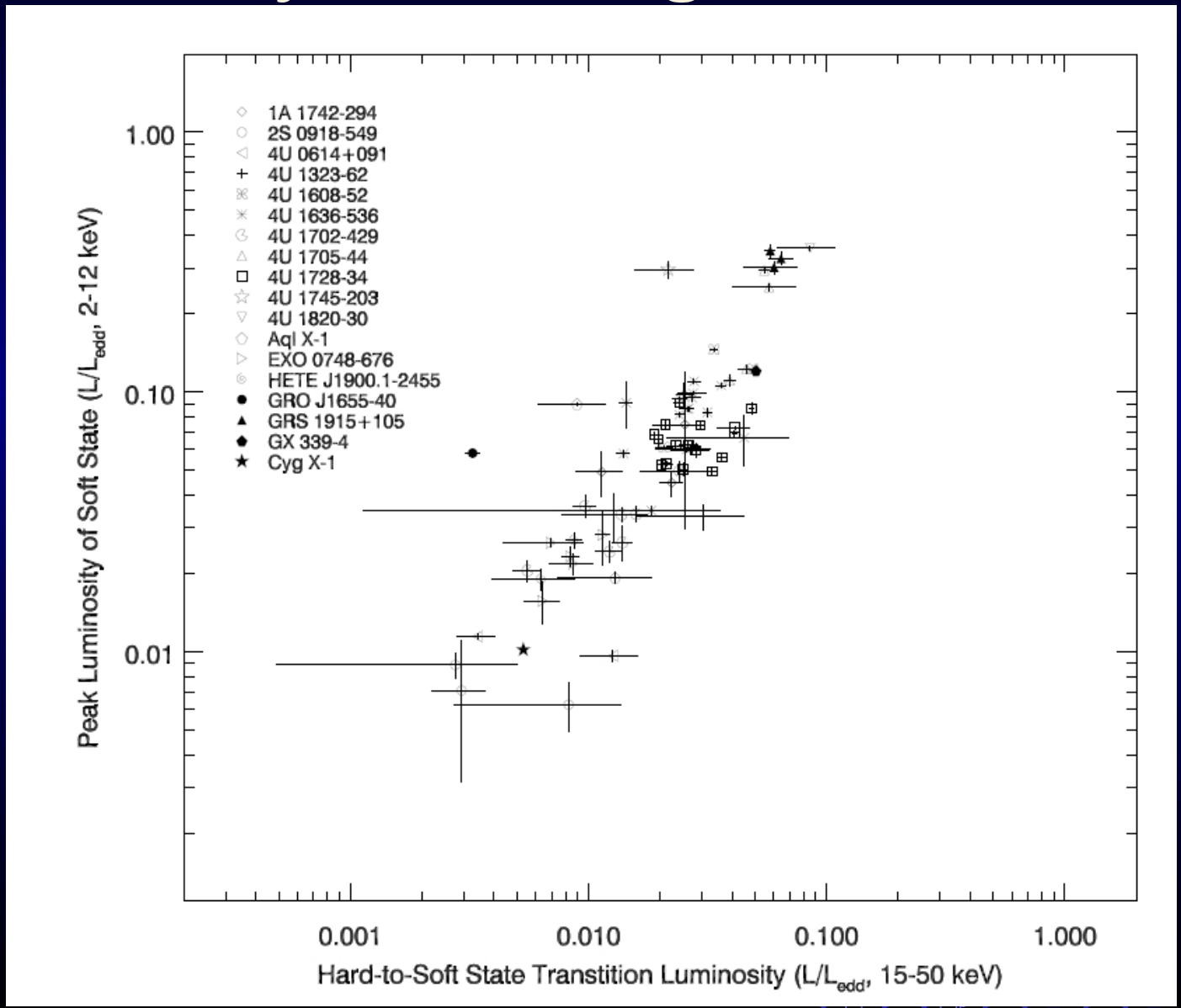

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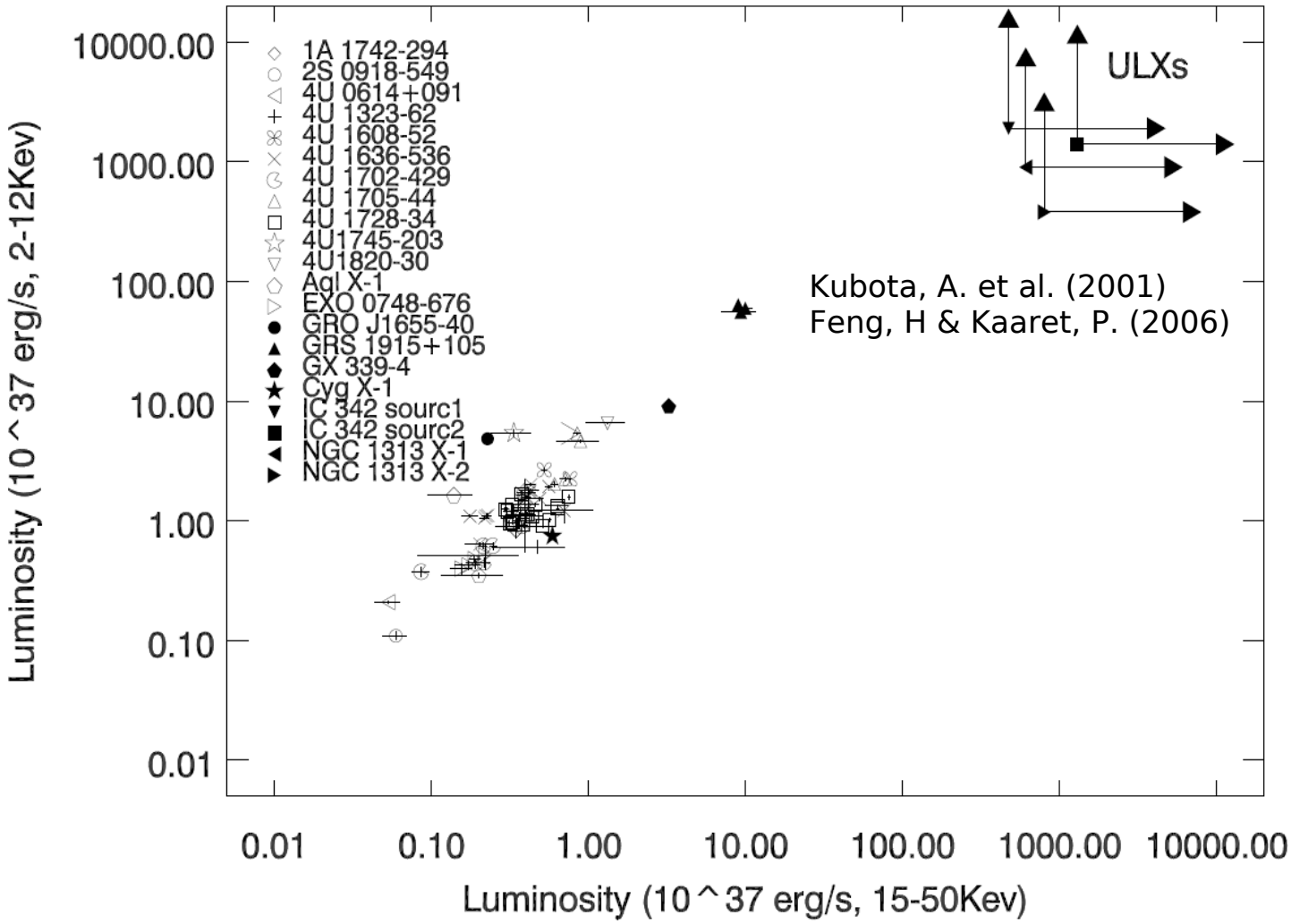

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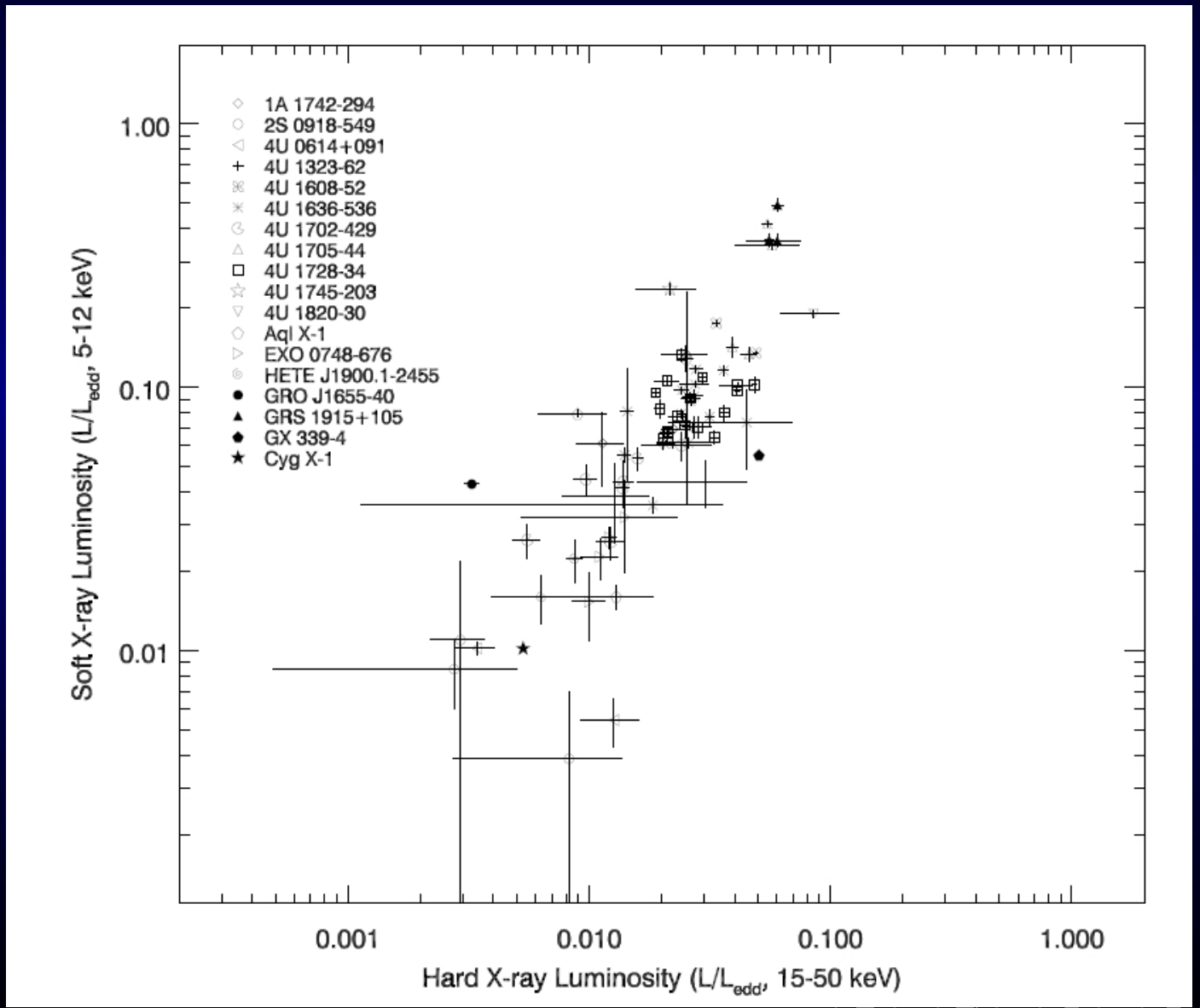

Discussion

- The luminosity corresponding to the hard-to-soft state transition varies by almost two orders of magnitude, the scale of which correlates with the soft X-ray outburst amplitude.
- Both transient sources and persistent sources meet the same linear correlation including Cygnus X-1.
- This correlation suggests that the accretion flow that powers hard state is somehow related to the accretion flow that powers soft state

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